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MEASUREMENT OF THE RADIOACTIVITY INDUCED BY COSMIC RADIATION IN THE BOGOU METEORITE

by

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MEASUREMENT OF THE RADIOACTIVITY INDUCED BY COSMIC RADIATION IN THE BOGOU METEORITE

Comptes-Rendus de l'Académie
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by Daniel Nordemann
& Jacques Tobailem

SUMMARY

The activities of γ — emitters contained in a sample of the Bogou meteorite, weighing 0.185 kg have been measured by quantitative γ — spectrometry of weak proper motion.

* • *

An iron meteorite with mass of 8.8 kg fell near Bougou (Volta) on 14 August 1962 at 10 00 hours.

Our laboratory received a sample weighing 0.185 kg, in a form of thin plate (6 mm) cut in the mass of meteorite (see Fig. 1). A first measurement was made 303 days after the fall and led to the evidence of an activity due to manganese 54 of 750 ± 75 dpm$\cdot$kg^{-1} [1].

A subsequent measurement, effected by Mabuchi over the same sample, but with a different standardization method, gave the value of 550 ± 55 dpm$\cdot$kg^{-1} [2].

We took over anew the study of that sample, using this time the γ — spectrometry, with new facilities permitting to obtain a background noise, weaker and more steady.

We have effected a series of measurements of long duration, up to 160 hours, spread between 680 and 760 days after the day of fall. Naturally, this time interval constitutes a disadvantage because of short-lived radionuclides (period $\leqslant$ 1 year), but, otherwise we may

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* Mesure de la radioactivité induite par le rayonnement cosmique dans la météorite de Bogou.

hope to detect more easily long-life radionuclides (sodium 22, cobalt 60, titanium 44, aluminum 26 etc.), which are much less concealed by the short-life radionuclides that have decreased.

The installation's calibration for these measurements was made by means of dummies simulating the meteorite sample.

Three dummies comprised calibrated sources of manganese 54, cobalt 60 and potassium 40. These models were materialized by interposing two plane sources, of homogenous distribution, between three stainless steel plates.

The following results, reduced to the date of the fall, have been obtained :

- ^{54}Mn (period of 313.5 days) [3] : 483 ± 40 dpm.kg^{-1};
- ^{22}Na (" 2.58 years) [4] : 0 ± 4 " ;
- ^{60}Co (" 5.27 years) [5] : 14 ± 7 " ;
- ^{44}Ti (" 200.0 years) [6] : 3.8 ± 3 " ;
- ^{26}Al (" 738,000 years) [7] : 4.3 ± 3 " .

The value obtained for the activity of manganese 54 in theBogou meteorite is in the vicinity of the values already published, that is 485^{+30}_{-85} dpm.kg^{-1} [8]; 439 ± 22 dpm.kg^{-1} [9]. It is to be compared with those indicated for Aroos iron meteorite (fall of 24 November 1959) : 470 ± 47 dpm.kg^{-1} [10]; 425 ± 40 dpm.kg^{-1} [11], and also with that obtained by Honda [12] by having the iron bombarded by 3 GeV protons : 440 dpm.kg^{-1}.

The value of activity in cobalt 60 is sensibly in agreement with those indicated by other authors : $\leqslant$ 7 ± 4 dpm.kg^{-1} [9], $\leqslant$ 13 dpm.kg^{-1} [8]. As to the activity in titanium 44 in the Bogou meteorite, no value has been published to-date.

The activity measured for aluminum 26 is in agreement with the value obtained by Shedlovskiy [13] after chemical separation, which is 3.81 ± 0.09 dpm.kg^{-1}.

In the iron meteorites, the principal formation modes of these nuclides, under the effect of cosmic radiation, are :

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- ^{54}Mn : spallation of iron by rapid secondary neutrons, ^{54}Fe (n,p) ^{54}Mn and ^{56}Fe (n, p2n) ^{54}Mn;
- ^{60}Co : capture of secondary thermal neutrons by cobalt, ^{59}Co (n, γ) ^{60}Co ;
- ^{44}Ti : spallation of iron, ^{56}Fe (p, 5p8n) ^{44}Ti;
- ^{26}Al : spallation of iron, ^{56}Fe (p, 14p 17n) ^{26}Al.

Thus. the activity of Mn 54 must be influenced by the size of the meteorite and by the position of the sample inside. This explains the results' grouping as regards manganese 54 for all the various samples of a same meteorite and for meteorites having been subject to a comparable irradiation in space.

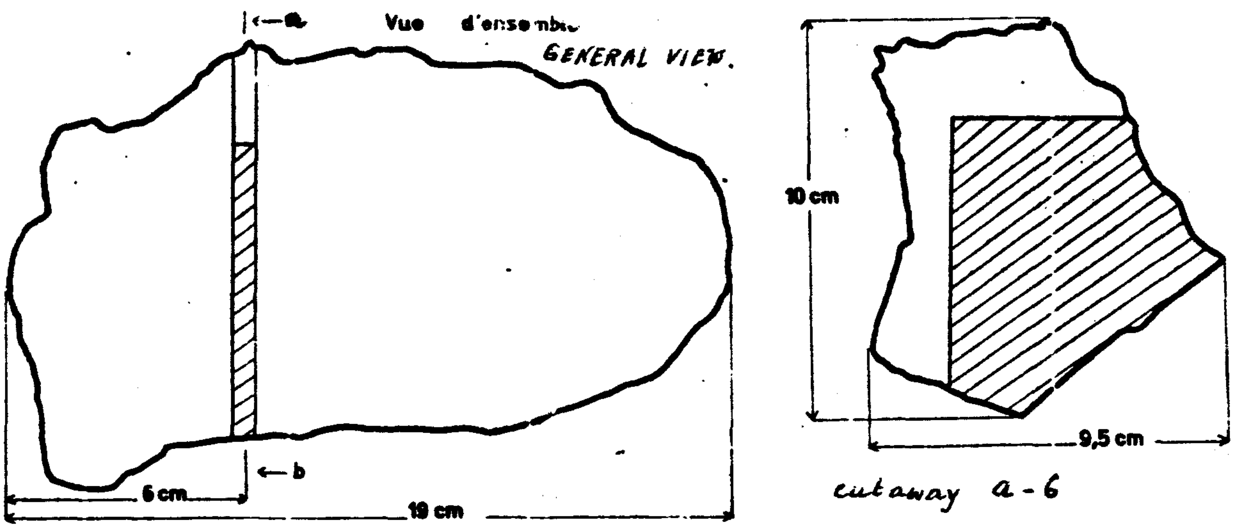

Fig. 1. - The Bogou Meteorite.
The hatched portion indicates the position of the 0.185 kg sample

To the contrary, the activity in cobalt 60 is a function of the shape of meteorite sample and of its position because of neutron production and thermalization [14]. On a meteorite of the size of that of Bogou the production of cobalt 60 at the center is more important that at the edges. This can explain the fact, that our measurement, made with the detector near center, gives an activity twice as great as that obtained by Rowe, Anderson and Van Dilla [9], who analyzed a much more voluminous sample (8.4 kg), where the edges played a prominent part.

*** THE END ***

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